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PATENT APPLICATION

ATTORNEY DOCKET NO. 200207604-1

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IN THE
UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Warren B. Jackson et al.

Confirmation No.:

Application No.: 10/608,791

Examiner: Matthew E. Warren

Filing Date: 06/26/2003

Group Art Unit: 2815

Title: POLYMER-BASED MEMORY ELEMENTS

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Commissioner For Patents
PO Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL OF APPEAL BRIEF

Sir:

Transmitted herewith is the Appeal Brief in this application with respect to the Notice of Appeal filed on **06/26/06**.

The fee for filing this Appeal Brief is (37 CFR 1.17(c)) $500.00.

(complete (a) or (b) as applicable)

The proceedings herein are for a patent application and the provisions of 37 CFR 1.136(a) apply.

( ) (a) Applicant petitions for an extension of time under 37 CFR 1.136 (fees: 37 CFR 1.17(a)-(d) for the total number of months checked below:

( )	one month	$120.00
( )	two months	$450.00
( )	three months	$1020.00
( )	four months	$1590.00

( ) The extension fee has already been filled in this application.

(X) (b) Applicant believes that no extension of time is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition and fee for extension of time.

Please charge to Deposit Account **08-2025** the sum of **$500.00**. At any time during the pendency of this application, please charge any fees required or credit any over payment to Deposit Account 08-2025 pursuant to 37 CFR 1.25. Additionally please charge any fees to Deposit Account 08-2025 under 37 CFR 1.16 through 1.21 inclusive, and any other sections in Title 37 of the Code of Federal Regulations that may regulate fees. A duplicate copy of this sheet is enclosed.

(X) I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, Alexandria, VA 22313-1450. Date of Deposit: Aug. 28, 2006

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Typed Name: Joanne Bourguignon

Signature: Joanne Bourguignon

Respectfully submitted,

Warren B. Jackson et al.

By Robert W. Bergstrom

Robert W. Bergstrom

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Rev 12/04 (Aplbrief)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of:

Inventors:	Warren B. Jackson et al.
Serial No.	10/608,791
Filed:	June 26, 2003
For:	POLYMER-BASED MEMORY ELEMENTS

Examiner: Matthew E. Warren
Group Art Unit: 2815
Docket No. 200207604-1
Date: August 28, 2006

APPEAL BRIEF

Mail Stop: Appeal Briefs – Patents
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Alexandria, VA 22313-1450

Sir:

This appeal is from the decision of the Examiner, in an Office Action mailed March 24, 2006, finally rejecting claims 1-32.

REAL PARTY IN INTEREST

The real party in interest is Hewlett-Packard Development Company, LP, a limited partnership established under the laws of the State of Texas and having a principal place of business at 20555 S.H. 249 Houston, TX 77070, U.S.A. (hereinafter "HPDC"). HPDC is a Texas limited partnership and is a wholly-owned affiliate of Hewlett-Packard Company, a Delaware Corporation, headquartered in Palo Alto, CA. The general or managing partner of HPDC is HPQ Holdings, LLC.

RELATED APPEALS AND INTERFERENCES

Applicants' representative has not identified, and does not know of, any other appeals of interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

STATUS OF CLAIMS

Claims 1-32 are pending in the application. Claims were finally rejected in the Office Action dated March 24, 2006. Applicants' appeal the final rejection of claims 1-32, which are copied in the attached CLAIMS APPENDIX.

STATUS OF AMENDMENTS

No Amendment After Final is enclosed with this brief. The last Response was filed January 5, 2006.

SUMMARY OF CLAIMED SUBJECT MATTER

Overview

The current invention is directed to a memory element containing an organic polymer layer that transitions between two different, detectable memory states that arise from changes in chemical bonds or changes in organic polymer doping within the organic polymer layer. A detailed discussion of certain of these chemical-bond or dopant change mechanisms begins on line 6 of page 9 of the current application, with reference to Figure 9. In a paragraph beginning on line 6 of page 9, an embodiment of the present invention is discussed in which *trans* double bonds are reversibly changed to *cis* bonds, or vice versa, or in which reversible protein-denaturing-like conformational changes occur (see 910 and 912 in Figure 9). In a paragraph beginning on line 27 of page 9, an embodiment of the present invention is discussed in which organic polymer chains are reversibly fractured or, alternatively, cross-linked together (see 914 and 916 in Figure 9). In a paragraph beginning on line 6 of page 10, an embodiment of the present invention is discussed in which dopant entities are driven into, or extracted from, an organic-polymer layer (see 918 and 920 in Figure 9). In a paragraph beginning on line 21 of page 10, an embodiment of the present invention is discussed in which chemical entities that enhance or decrease the doping efficiencies of dopants within an

organic polymer chains are reversibly driven into, or extracted from, the organic polymer layer (see 926 and 928 in Figure 9). In a paragraph beginning on line 9 of page 11, an embodiment of the present invention is discussed in which reversible reduction of double bonds to single bonds or oxidation of single bonds to double bonds within an organic polymer layer occur (see 932 and 934 in Figure 9). The present invention is contrasted, in the Background of the Invention section of the current application, with currently available devices in which an organic-polymer layer is vaporized or otherwise irreversibly and physically destroyed using high energy input for lengthy periods of time (Figures 2A-B).

Independent Claim 1

Independent claim 1 is directed to an organic-polymer-based memory element comprising: (1) two overlapping conductive signals lines (1002, 1004 and 1108, 1110); and (2) at least one organic polymer layer (1008, 1104) within the region of overlap between the two signal lines, the organic polymer layer having at least two detectable memory states, transitions between which (908) arise from one of changes in chemical bonds and changes in organic polymer doping. In other words, claim 1 claims a memory element that can reversibly transition between memory states by means of relatively low-energy and fast changes to chemical bonds or dopants, as discussed in the current application beginning on line 6 of page 9, with reference to Figure 9.

Dependent Claims 2 – 32

Dependent claim 2 is directed to the memory element of claim 1 wherein, in a first memory state, the organic polymer layer exhibits a first electrical resistivity and wherein, in the second memory state, the organic polymer layer exhibits a second electrical resistivity lower than the first resistivity, the organic-polymer-based memory element therefore an antifuse-type memory element (Figure 11). Dependent claim 3 is directed to the organic-polymer-based memory element of claim 2 wherein a memory-state transition is initiated by applying to the organic-polymer-based memory element one or more state-transition-facilitating agents selected from among: heating; cooling; an electrical voltage potential; a chemical potential; an electrochemical potential; electrical current; electromagnetic radiation; and a magnetic field. Dependent claim 4 is directed to the organic-polymer-based memory

element of claim 3 wherein the organic polymer layer includes dopant chemical entities in addition to organic polymers, the dopant chemical entities inactive in the first memory state and active in the second memory state (see 926 and 928 in Figure 9). Dependent claim 5 is directed to the organic-polymer-based memory element of claim 3 wherein the organic polymer layer is adjacent to an additional layer within the memory element, the additional layer including dopant chemical entities, a memory-state transition ensuing when dopant entities within the additional layer are driven into the organic polymer layer (see 918 and 920 in Figure 9). Dependent claim 6 is directed to the organic-polymer-based memory element of claim 3 wherein organic polymers within the organic polymer layer are disordered, a memory-state transition ensuing when organic polymers within the organic polymer layer align with one another (see 910 and 912 in Figure 9). Dependent claim 7 is directed to the organic-polymer-based memory element of claim 3 wherein the organic polymer layer is adjacent to an additional layer within the memory element, the organic polymer layer including cross-linking chemical entities, a memory-state transition ensuing when the cross-linking chemical entities are driven from the organic polymer layer into the additional layer (see 914 and 916 in Figure 9). Dependent claim 8 is directed to the organic-polymer-based memory element of claim 3 wherein the organic polymer layer is adjacent to an additional layer within the memory element, the organic polymer layer including polymer-chain-breaking chemical entities, a memory-state transition ensuing when the polymer-chain-breaking chemical entities are driven from the organic polymer layer into the additional layer to restore broken polymer chains to an unbroken state. Dependent claim 9 is directed to the organic-polymer-based memory element of claim 3 wherein the organic polymer layer includes cross-linking chemical entities, a memory-state transition ensuing when the cross-linking chemical entities are driven from the organic polymer layer into the additional layer (see 914 and 916 in Figure 9). Dependent claim 10 is directed to the organic-polymer-based memory element of claim 3 wherein the organic polymer layer includes polymer-chain-breaking chemical entities, a memory-state transition ensuing when the polymer-chain-breaking chemical entities are deactivated to restore broken polymer chains to an unbroken state. Dependent claim 11 is directed to the organic-polymer-based memory element of claim 3 wherein the organic polymer layer includes dopant chemical entities and dopant-inhibiting chemical entities in addition to organic polymers, a memory-state transition ensuing when the dopant entities within the organic polymer layer are deactivated (see 926 and 928 in Figure 9). Dependent claim 12 is directed to the organic-polymer-based memory element of claim 3

wherein the organic polymer layer includes dopant chemical entities, wherein the organic polymer layer is adjacent to an additional layer within the memory element, the additional layer including dopant-inhibiting chemical entities, a memory-state transition ensuing when the dopant-inhibiting chemical entities are driven from within the organic polymer layer into additional layer (see 926 and 928 in Figure 9). Dependent claim 13 is directed to the organic-polymer-based memory element of claim 3 wherein the organic polymer layer includes a reactant that can add to a carbon-carbon double bond to produce substituted carbons joined by a single carbon-carbon bond (see 932 and 934 in Figure 9), wherein the organic polymer layer is adjacent to an additional layer within the memory element, a memory-state transition ensuing when the reactant from the organic polymer layer is driven into the additional layer to restore broken polymer chains to an unbroken state.

Dependent claim 14 is directed to the organic-polymer-based memory element of claim 1 wherein, in the first memory state, the organic polymer layer exhibits a first electrical resistivity and wherein, in the second memory state, the organic polymer layer exhibits a second electrical resistivity higher than the first resistivity, the organic-polymer-based memory element therefore a fuse-type memory element (Figure 10). Dependent claim 15 is directed to the organic-polymer-based memory element of claim 14, wherein a memory-state transition is initiated by applying to the organic-polymer-based memory element one or more state-transition-facilitating agents selected from among: heating; cooling; an electrical voltage potential; a chemical potential; an electrochemical potential; electrical current; electromagnetic radiation; and a magnetic field. Dependent claim 16 is directed to the organic-polymer-based memory element of claim 15 wherein the organic polymer layer includes dopant chemical entities in addition to organic polymers, the dopant chemical entities inactive in the first memory state and active in the second memory state, a memory-state transition ensuing when the dopant entities within the organic polymer layer are deactivated (see 926 and 928 in Figure 9). Dependent claim 17 is directed to the organic-polymer-based memory element of claim 15 wherein the organic polymer layer is adjacent to an additional layer within the memory element, a memory-state transition ensuing when the dopant entities are driven from within the organic polymer layer to the additional layer (see 918 and 920 in Figure 9). Dependent claim 18 is directed to the organic-polymer-based memory element of claim 15 wherein organic polymers within the organic polymer layer are aligned, a memory-state transition ensuing when the organic polymers are disordered with respect to one another within the organic polymer layer (see 910 and 912 in Figure 9).

Dependent claim 19 is directed to the organic-polymer-based memory element of claim 15 wherein the organic polymer layer is adjacent to an additional layer within the memory element that contains cross-linking chemical entities, a memory-state transition ensuing when the cross-linking chemical entities are driven from the additional layer into the organic polymer layer (see 914 and 916 in Figure 9). Dependent claim 20 is directed to the organic-polymer-based memory element of claim 15 wherein the organic polymer layer is adjacent to an additional layer within the memory element that contains polymer-chain-breaking chemical entities, a memory-state transition ensuing when the polymer-chain-breaking chemical entities are driven into the organic polymer layer from the additional layer. Dependent claim 21 is directed to the organic-polymer-based memory element of claim 15 wherein the organic polymer layer includes cross-linking chemical entities, a memory-state transition ensuing when the cross-linking chemical entities are activated (see 914 and 916 in Figure 9). Dependent claim 22 is directed to the organic-polymer-based memory element of claim 15 wherein the organic polymer layer includes polymer-chain-breaking chemical entities, a memory-state transition ensuing when the polymer-chain-breaking chemical entities are activated. Dependent claim 23 is directed to the organic-polymer-based memory element of claim 15 wherein the organic polymer layer includes dopant chemical entities and dopant-inhibiting chemical entities in addition to organic polymers, a memory-state transition ensuing when the dopant entities within the organic polymer layer are activated (see 918 and 920 in Figure 9). Dependent claim 24 is directed to the organic-polymer-based memory element of claim 15 wherein the organic polymer layer includes dopant chemical entities, wherein the organic polymer layer is adjacent to an additional layer within the memory element, the additional layer including dopant-inhibiting chemical entities, a memory-state transition ensuing when the dopant-inhibiting chemical entities are driven into the organic polymer layer from the additional layer (see 918 and 920 in Figure 9). Dependent claim 25 is directed to the organic-polymer-based memory element of claim 15 wherein the organic polymer layer is adjacent to an additional layer within the memory element that includes a reactant that can add to a carbon-carbon double bond to produce substituted carbons joined by a single carbon-carbon bond, a memory-state transition ensuing when the reactant is driven into the organic polymer layer from the additional layer (see 932 and 934 in Figure 9).

Dependent claim 26 is directed to the organic-polymer-based memory element of claim 1 wherein, upon application of a switch, the memory element irreversibly transitions from the first memory state to the second memory state. Dependent claim 27 is directed to

the organic-polymer-based memory element of claim 1 wherein, upon application of the switch, the memory element reversibly transitions from a first memory state to a second memory state under, subsequently transitioning back to the first memory state in response to application of a second switch. Dependent claim 28 is directed to a two-dimensional memory array fashioned from memory elements of claim 1 (Figure 1). Dependent claim 29 is directed to an electronic device containing the two-dimensional memory array of claim 28, switching between memory states of the memory elements of the two-dimensional memory array to store data values. Dependent claim 30 is directed to a three-dimensional memory array fashioned from memory elements of claim 1. Dependent claim 31 is directed to an electronic device containing the two-dimensional memory array of claim 30, switching between memory states of the memory elements of the three-dimensional memory array to store data values. Dependent claim 2 is directed to a computer system comprising: a processor; and a memory comprising a number of memory elements of claim 1.

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Whether the Examiner properly rejected Applicants' Rule 131 Affidavit.

2. Whether claim 1 is anticipated under 35 U.S.C. §102(e) by Stasiak, U.S. Patent Application Publication No. 2003/0230746 A1 ("Stasiak"), Krieger et al., U.S. Patent Application Publication No. 2004/0246768 A1 ("Krieger"), or Chow, U.S. Patent No. 6,646,903 B2 ("Chow"), and whether any of the dependent claims 2 - 32 are therefore anticipated by any of Stasiak, Krieger, or Chow.

ARGUMENT

In an Office Action dated March 24, 2006 ("Office Action"), the Examiner rejected claim 1 under 35 U.S.C. §102(e) as being anticipated by Stasiak, U.S. Patent Application Publication No. 2003/0230746 A1 ("Stasiak"), rejected claims 1-27 and 32 under 35 U.S.C. §102(e) as being anticipated by Krieger et al., U.S. Patent Application Publication No. 2004/0246768 A1 ("Krieger"), rejected claims 1-3, 14, 15, and 28-32 under 35 U.S.C. §102(e) as being anticipated by Chow, U.S. Patent No. 6,646,903 B2 ("Chow"), and maintained the Examiner's previous rejection of Applicants' Rule131 Affidavit. Applicants' representative respectfully traverses the rejections of the current claims

ISSUE 1

1. Whether the Examiner properly rejected Applicants' Rule 131 Affidavit.

In the Office Action, on page 6, the Examiner responds to Applicants' arguments with regard to the Rule 131 Affidavit submitted by Applicants' representative on July 15, 2005, as follows:

> Again, the Examiner believes that the evidence submitted is insufficient to establish diligence from a date prior to the date of reduction to practice of the Stasiak reference to either a constructive reduction to practice or an actual reduction to practice. *The evidence submitted only discloses the chemical composition of and process of making polymers, which has nothing to do with the claimed invention.* There is nothing in the evidence that suggests diligence in making an organic-polymer based memory element comprising two overlapping conductive signal lines, which is the claimed invention. *Nothing in the evidence shows that the organic polymer layer has at least two detectable memory states.* So, one of ordinary skill in the art would not be able to ascertain that the evidence submitted pertains to an a memory element. *The only discernable information that can be obtained from the declaration is that the applicant invented an organic polymer, which could be used in anything (such as the insulating layer of a printed circuit board).* (emphasis added)

The Affidavit submitted on July 15, 2005, includes eight exhibits dated from March 11, 2002, to June 7, 2002, all prior to the July 14, 2002 filing date of Stasiak. These exhibits show a variety of different data collected from experimental investigation of memory devices, or switches, fabricated from organic polymers and overlapping conductive materials according to the current invention. For example, Exhibit 1 shows two different families of current/voltage curves obtained by measuring the current through memory-element embodiments of the current invention comprising a 3, 4, 9, 10-perylenetetracarboxylic dianhydride ("PTCDA") organic layer sandwiched between aluminum and silver electrodes, as clearly shown in the legends of the figures. Contrary to the Examiner's statement, such current/voltage curves are not directed to the chemical composition of, or process of making, polymers, but instead show observed electronic characteristics of a memory-element embodiment of the present invention. Current/voltage curves are direct, experimental data obtained from devices. Moreover, the two families of current/voltage curves show two different resistance states of the organic polymer. Two different resistance states are used, as described throughout the current application, including on lines 4 - 7 of page 4, in various

embodiments as two different memory states. The remaining exhibits include similar, detailed materials showing observed electronic characteristics of various memory-element embodiments of the present invention. For example, Exhibit 3 discusses a memory element comprising a PTCDA layer sandwiched between a *p*-silicon substrate and a gold contact. As another example, on the third page of Exhibit 4, an illustration of the changes observed in a cathode of a memory-element device after stressing the device is shown. The terms "cathode" and "device" clearly reference an electronic device, and not the chemical composition of, or process of making, a polymer. On the first page of Exhibit 8, as yet another example, a diagram of a memory element is shown with an upper gold contact, a poly(3,4-ethylenedioxythiophene) ("PEDT") poly(styrenesulfonate) ("PSS") organic layer, and a lower indium-tin oxide ("ITO") conductive element. Indeed, Exhibit 6 does include several pages of chemical structures, but this represents only a tiny fraction of the material included in Exhibits 1-8.

One cannot generate current/voltage curves from a chemical structure or process for making an organic polymer - such curves are generated by fabricating an electrical device to which voltages can be applied and through which currents can be measured. The Examiner's statement is unfounded, and makes no sense. Applicants' representative is left with the impression that the Examiner has not read the Rule 131 Affidavit and exhibits submitted on July 15, 2005. Together, the two Rule 131 Affidavits submitted by Applicants' representative unambiguously show conception of the current invention and reduction to practice of the current invention prior to the June 14, 2002, filing date of Stasiak, as well as diligence in pursuing preparation and filing of current application.

ISSUE 2

2. Whether claim 1 is anticipated under 35 U.S.C. §102(e) by Stasiak, U.S. Patent Application Publication No. 2003/0230746 A1 ("Stasiak"), Krieger et al., U.S. Patent Application Publication No. 2004/0246768 A1 ("Krieger"), or Chow, U.S. Patent No. 6,646,903 B2 ("Chow"), and whether any of the dependent claims 2 - 32 are therefore anticipated by any of Stasiak, Krieger, or Chow.

Claim 1 is provided below for the Reader's convenience:

> 1. An organic-polymer-based memory element comprising:
> two overlapping conductive signals lines; and
> at least one organic polymer layer within the region of overlap between the two signal lines, the organic polymer layer having at least two detectable memory states, transitions between which arise from one of changes in chemical bonds and changes in organic polymer doping.

According to MPEP § 2131:

> "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." ... "The identical invention must be shown in as complete detail as is contained in the ... claim."

Claim 1 is thus directed to an organic-polymer-based memory element with an organic polymer layer in which changes in chemical bonds or changes in organic-polymer doping lead to two different, detectable memory states. Claim 1 includes the element: "at least one organic polymer layer within the region of overlap between the two signal lines, the organic polymer layer having at least two detectable memory states, *transitions between which arise from one of changes in chemical bonds and changes in organic polymer doping*" (emphasis added). In other words, claim 1 is directed to an organic polymer layer within a memory element that reversibly transitions between two states via reversible changes in chemical bonds or in organic polymer doping. As discussed above, the current application provides a number of explicit examples of such chemical-bond and organic-polymer-doping changes.

The Examiner cites paragraph [0023] of Stasiak as teaching or disclosing an organic-polymer layer within a memory element in which transitions between memory states arise from changes in chemical bonds or changes in organic polymer doping. As discussed above, Stasiak is not a citable reference, having a filing date later than Applicants' reduction to practice of the claimed invention. Moreover, paragraph [0023] of Stasiak, reproduced below, does not mention transitions between detectable memory states:

> **[0023]** Organic dopant material **112** may contain either electron donor or electron acceptor molecules, or functional groups, or a mixture of both in a polymer host or binder. In an alternate embodiment, semiconducting polymer film **120** may include separate electron donor and electron acceptor layers. Organic dopant material **112** may provide a trapping site for injected charge. Charge transport, in the form of hole or electron transport, may thus occur between adjacent donor or acceptor molecules,

> respectively. Such a process can be described as a one-electron oxidation or reduction process between neutral functional groups and their charged derivatives. The transport process, in semiconducting polymer film **120**, will depend on the dopant molecule or functional group, the dopant concentration, and the polymer host or binder material. The particular molecule or functional group utilized will depend on the particular electrical characteristics desired for memory device **100**, as well as the particular application memory device will be utilized in. The electron donor or acceptor functional groups, of the present invention, can be associated with a dopant molecule, pendant groups of a polymer, or the polymer main chain itself.

The cited paragraph merely describes organic doping material in a polymer host or binder. Stasiak mentions charge transport, in the form of hole or electron transport, but does not describe injection of dopant molecules into, and/or extraction of dopant molecules from, the organic polymer. The current claim 1, quoted above, is not merely directed to a memory element containing an organic-polymer layer, but is instead directed to a memory element in which transitions between detectable memory states arise from changes in chemical bonds or organic-polymer doping. This paragraph falls far short of teaching a memory element in which transitions between detectable memory states arise from changes in chemical bonds or organic-polymer doping. Conductive polymers and doped conductive polymers are well known in the fields of electronics and materials science. Transitions between detectable memory states in an organic-polymer layer do not imply changes in chemical bond of in organic-polymer doping. Such transitions may result from accumulation of charge, changes in polymer orientations, and from many other changes that do not involve changing chemical bonds or organic-polymer doping. In fact, in paragraphs [0038-40], in describing operation of his memory element, Stasiak explicitly states that the trapping of charge by the organic dopant is responsible for generating a polarization current by which the memory state can be determined. For example, in paragraph [0040], Stasiak states: "The physical displacement of the trapped charge, responding to the voltage impulse **710**, generates a measurable polarization current as shown in **FIG. 7**." In other words, it is accumulation of charge, rather than changes in chemical bonds and changes in organic polymer doping, to which Stasiak explicitly attributes the electronic properties of his memory cell. Paragraph [0023] of Stasiak neither discloses, teaches, mentions, nor suggests memory-state transitions of any kind, and neither makes mention .nor suggests memory-state transitions that involve chemical-bond changes or organic-polymer doping changes, and paragraphs [0038-40] of Stasiak explicitly

state that the memory cell states result from accumulation of charge, and not from changing chemical bonds or the dopant within the organic polymer.

Similarly, the Examiner cites paragraph [0019] of Krieger for teaching transitions between detectable memory states arising from changes in chemical bonds or changes in organic-polymer doping. Paragraph [0019] is provided below:

> It is beneficial to implement the memory cell functional zone consisting of an active layer based on organic and metalorganic conjugate polymers with active elements built into the main circuit and/or connected to the circuit or to the plane and/or built into the structure, with the elements forming or not forming a light emitting structure, or of an active layer based on organic, metalorganic and non-organic materials with instilled positive or negative ions, including molecular ions, and/or with instilled clusters based on solid electrolytes or with molecules and/or ions with an electric dipole moment, and/or with clusters based on solid polymer and non-organic ferroelectrics, and/or with donor and acceptor molecules, and/or with organic and/or non-organic salts and/or acids and/or water molecules, and/or with molecules that can dissociate in an electric field and/or under light radiation, and/or with non-organic and/or metalorganic and/or organic salts and/or molecules with variable valency of metals or atomic groups the contain. The described implementation of the functional zone allows to create a structure capable of changing the active layer resistance and/or forming high conductivity areas or lines in the active layer under external electric and/or light radiation effect on the memory cell and retaining this state for a long time without applying external electric fields.

The cited paragraph of Krieger only states that the "described implementation of the functional zone allows to create a structure capable of changing the active layer resistance and/or forming high conductive areas or lines in the active layer under external electric and/or light radiation effect on the memory cell and retaining the state for a long time without applying external electric fields." Krieger proposes a wide variety of different types of memory-element materials, including organic materials, inorganic materials, and other more specific embodiments. *However, nowhere in paragraph [0019] does Krieger mention transitions between detectable memory states arising from changes in chemical bonds or changes in organic-polymer doping.* Instead, Krieger simply provides a long list of types of materials, many quite different from one another, and having quite different chemical, electrical, and physical characteristics, and then merely states a goal for the material. Changes in resistance or conductivity do not imply changes in chemical bonds and/or changes in organic-polymer doping, as discussed above, but may arise from a wide variety of

different types of charge-accumulation and polymer-orientation changes that do not involve changes in chemical bonds or organic-polymer doping. Moreover, Krieger does not mention or suggest that the state change is reversible.

Similarly, the Examiner cites column 2, lines 11-25 of Chow for teaching an organic-polymer layer in which transitions between detectable memory states arise from changes in chemical bonds or changes in organic polymer doping. However, the cited portion of Chow does not teach that for which it is cited:

> Ferroelectric memories may take many forms. One example of such a memory is a polymer ferroelectric memory. In this memory, a layer of organic polymer is sandwiched between two layers of electrodes. The organic polymer has ferroelectric properties that allow a change in the polarization state to indicate a '1' or a '0.' ...
>
> An example of a cell **10** of such an array is shown in **FIG. 1**. The organic material **16** is sandwiched between electrodes, such as **20** and **22**. Electrode **20** may be further connected to other cells in the array as a word line and electrode **22** as a bit line. Data is stored in the array by application of an electric field through these electrodes. The organic material has properties such that polarization shifts remain after a removal of the field.

Chow merely states that data is stored by an application of an electric field through electrodes between which an organic polymer layer is sandwiched. Chow explicitly states that the organic material "has properties such that polarization shifts remain after removal of the field." Again, as with the citations of paragraphs in Stasiak and Krieger, the cited portion of Chow does not teach, mention, or suggest transitions between detectable memory states arising from changes in chemical bonds or organic-polymer doping. Changes in polarization do not imply changes in chemical bonds and/or changes in organic-polymer doping.

Claims 2-32 all depend either directly or indirectly from claim 1, and are not therefore anticipated by any of the cited references for the same reason that claim 1 is not anticipated. Moreover, specific rejections of many of the dependent claims are completely unsupported by the cited references. For example, claim 4 is directed to embodiments of the present invention in which organic-polymer dopants are active in one memory state and inactive in another memory state. The Examiner cites Figure 5 of Krieger as anticipating claim 4. Neither Figure 5 of Krieger nor any text referencing Figure 5 in Krieger teach, disclose, mention, or suggest a memory cell in which organic-polymer dopants are active in one memory state and inactive in another memory state. To anticipate a claim, a reference must teach or disclose each and every element of a claim. A simple figure representing a

memory element cannot possibly teach or disclose differentiable memory states that depend on the activity of organic-polymer dopants. As another example, the Examiner cites Figure 5 with respect to all of claims 4-13, which are directed to a variety of different embodiments of the present invention, including embodiments that involve polymer alignments, disordered and ordered states of polymers, and many other embodiments. There is no mention or suggestion of any of these embodiments in Figure 5 of Krieger, or in those portions of Krieger that reference Figure 5. The Examiner states that the "organic polymer layer and additional layer inherently have all of the memory-state transition properties of the claims because the structure and materials are the same as those of the claimed invention." However, the structure of organic polymer materials, and characteristics and properties of such materials in an electronic device, depend critically on methods of preparing the materials, concentrations of dopants and other additives, polymer-chain lengths, exact chemical composition of various substituents and functional groups, degree of cross-linking within the polymers, operational regimes and characteristics of devices constructed from the materials, and many different additional characteristics. None of these parameters and characteristics are specified or suggested in Krieger. From a materials science or chemical perspective, the above quoted statement is unsupported and unsupportable.

CONCLUSION

Applicants have shown clearly, in two Rule 131 Affidavits, that they conceived of the current invention prior to the July 14, 2002 filing date of Stasiak and worked diligently to reduce the invention to practice until the current application was filed, on June 26, 2003. None of the cited references Stasiak, Krieger, and Chow anticipate claim 1, and, because claim 1 is not anticipated, none of the remaining claims that depend from claim 1 are anticipated.

Applicants respectfully submits that all statutory requirements are met and that the present application is allowable over all the references of record. Therefore, Applicants respectfully requests that the present application be passed to issue.

Respectfully submitted,
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CLAIMS APPENDIX

1. (original) An organic-polymer-based memory element comprising:

two overlapping conductive signals lines; and

at least one organic polymer layer within the region of overlap between the two signal lines, the organic polymer layer having at least two detectable memory states, transitions between which arise from one of changes in chemical bonds and changes in organic polymer doping.

2. (original) The organic-polymer-based memory element of claim 1 wherein, in a first memory state, the organic polymer layer exhibits a first electrical resistivity and wherein, in the second memory state, the organic polymer layer exhibits a second electrical resistivity lower than the first resistivity, the organic-polymer-based memory element therefore an antifuse-type memory element.

3. (original) The organic-polymer-based memory element of claim 2, wherein a memory-state transition is initiated by applying to the organic-polymer-based memory element one or more state-transition-facilitating agents selected from among:

heating;

cooling;

an electrical voltage potential;

a chemical potential;

an electrochemical potential;

electrical current;

electromagnetic radiation; and

a magnetic field.

4. (original) The organic-polymer-based memory element of claim 3 wherein the organic polymer layer includes dopant chemical entities in addition to organic polymers, the dopant chemical entities inactive in the first memory state and active in the second memory state.

5. (original) The organic-polymer-based memory element of claim 3 wherein the organic polymer layer is adjacent to an additional layer within the memory element, the additional

layer including dopant chemical entities, a memory-state transition ensuing when dopant entities within the additional layer are driven into the organic polymer layer.

6. (original) The organic-polymer-based memory element of claim 3 wherein organic polymers within the organic polymer layer are disordered, a memory-state transition ensuing when organic polymers within the organic polymer layer align with one another.

7. (original) The organic-polymer-based memory element of claim 3 wherein the organic polymer layer is adjacent to an additional layer within the memory element, the organic polymer layer including cross-linking chemical entities, a memory-state transition ensuing when the cross-linking chemical entities are driven from the organic polymer layer into the additional layer.

8. (original) The organic-polymer-based memory element of claim 3 wherein the organic polymer layer is adjacent to an additional layer within the memory element, the organic polymer layer including polymer-chain-breaking chemical entities, a memory-state transition ensuing when the polymer-chain-breaking chemical entities are driven from the organic polymer layer into the additional layer to restore broken polymer chains to an unbroken state.

9. (original) The organic-polymer-based memory element of claim 3 wherein the organic polymer layer includes cross-linking chemical entities, a memory-state transition ensuing when the cross-linking chemical entities are driven from the organic polymer layer into the additional layer.

10. (original) The organic-polymer-based memory element of claim 3 wherein the organic polymer layer includes polymer-chain-breaking chemical entities, a memory-state transition ensuing when the polymer-chain-breaking chemical entities are deactivated to restore broken polymer chains to an unbroken state.

11. (original) The organic-polymer-based memory element of claim 3 wherein the organic polymer layer includes dopant chemical entities and dopant-inhibiting chemical entities in addition to organic polymers, a memory-state transition ensuing when the dopant entities within the organic polymer layer are deactivated.

12. (original) The organic-polymer-based memory element of claim 3 wherein the organic polymer layer includes dopant chemical entities, wherein the organic polymer layer is adjacent to an additional layer within the memory element, the additional layer including dopant-inhibiting chemical entities, a memory-state transition ensuing when the dopant-inhibiting chemical entities are driven from within the organic polymer layer into additional layer.

13. (original) The organic-polymer-based memory element of claim 3 wherein the organic polymer layer includes a reactant that can add to a carbon-carbon double bond to produce substituted carbons joined by a single carbon-carbon bond, wherein the organic polymer layer is adjacent to an additional layer within the memory element, a memory-state transition ensuing when the reactant from the organic polymer layer is driven into the additional layer to restore broken polymer chains to an unbroken state.

14. (original) The organic-polymer-based memory element of claim 1 wherein, in the first memory state, the organic polymer layer exhibits a first electrical resistivity and wherein, in the second memory state, the organic polymer layer exhibits a second electrical resistivity higher than the first resistivity, the organic-polymer-based memory element therefore a fuse-type memory element.

15. (original) The organic-polymer-based memory element of claim 14, wherein a memory-state transition is initiated by applying to the organic-polymer-based memory element one or more state-transition-facilitating agents selected from among:

heating;
cooling;
an electrical voltage potential;
a chemical potential;
an electrochemical potential;
electrical current;
electromagnetic radiation; and
a magnetic field.

16. (original) The organic-polymer-based memory element of claim 15 wherein the organic polymer layer includes dopant chemical entities in addition to organic polymers, the dopant chemical entities inactive in the first memory state and active in the second memory state, a memory-state transition ensuing when the dopant entities within the organic polymer layer are deactivated.

17. (original) The organic-polymer-based memory element of claim 15 wherein the organic polymer layer is adjacent to an additional layer within the memory element, a memory-state transition ensuing when the dopant entities are driven from within the organic polymer layer to the additional layer.

18. (original) The organic-polymer-based memory element of claim 15 wherein organic polymers within the organic polymer layer are aligned, a memory-state transition ensuing when the organic polymers are disordered with respect to one another within the organic polymer layer.

19. (original) The organic-polymer-based memory element of claim 15 wherein the organic polymer layer is adjacent to an additional layer within the memory element that contains cross-linking chemical entities, a memory-state transition ensuing when the cross-linking chemical entities are driven from the additional layer into the organic polymer layer.

20. (original) The organic-polymer-based memory element of claim 15 wherein the organic polymer layer is adjacent to an additional layer within the memory element that contains polymer-chain-breaking chemical entities, a memory-state transition ensuing when the polymer-chain-breaking chemical entities are driven into the organic polymer layer from the additional layer.

21. (original) The organic-polymer-based memory element of claim 15 wherein the organic polymer layer includes cross-linking chemical entities, a memory-state transition ensuing when the cross-linking chemical entities are activated.

22. (original) The organic-polymer-based memory element of claim 15 wherein the organic polymer layer includes polymer-chain-breaking chemical entities, a memory-state transition

ensuing when the polymer-chain-breaking chemical entities are activated.

23. (original) The organic-polymer-based memory element of claim 15 wherein the organic polymer layer includes dopant chemical entities and dopant-inhibiting chemical entities in addition to organic polymers, a memory-state transition ensuing when the dopant entities within the organic polymer layer are activated.

24. (original) The organic-polymer-based memory element of claim 15 wherein the organic polymer layer includes dopant chemical entities, wherein the organic polymer layer is adjacent to an additional layer within the memory element, the additional layer including dopant-inhibiting chemical entities, a memory-state transition ensuing when the dopant-inhibiting chemical entities are driven into the organic polymer layer from the additional layer.

25. (original) The organic-polymer-based memory element of claim 15 wherein the organic polymer layer is adjacent to an additional layer within the memory element that includes a reactant that can add to a carbon-carbon double bond to produce substituted carbons joined by a single carbon-carbon bond, a memory-state transition ensuing when the reactant is driven into the organic polymer layer from the additional layer.

26. (original) The organic-polymer-based memory element of claim 1 wherein, upon application of a switch, the memory element irreversibly transitions from the first memory state to the second memory state.

27. (original) The organic-polymer-based memory element of claim 1 wherein, upon application of the switch, the memory element reversibly transitions from a first memory state to a second memory state under, subsequently transitioning back to the first memory state in response to application of a second switch.

28. (original) A two-dimensional memory array fashioned from memory elements of claim 1.

29. (original) An electronic device containing the two-dimensional memory array of claim 28, switching between memory states of the memory elements of the two-dimensional

memory array to store data values.

30. (original) A three-dimensional memory array fashioned from memory elements of claim 1.

31. (original) An electronic device containing the two-dimensional memory array of claim 30, switching between memory states of the memory elements of the three-dimensional memory array to store data values.

32. (original) A computer system comprising:

a processor; and

a memory comprising a number of memory elements of claim 1.

EVIDENCE APPENDIX

None.

RELATED PROCEEDINGS APPENDIX

None.